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A MONOGRAPH
ON
Iron and Steel Work.

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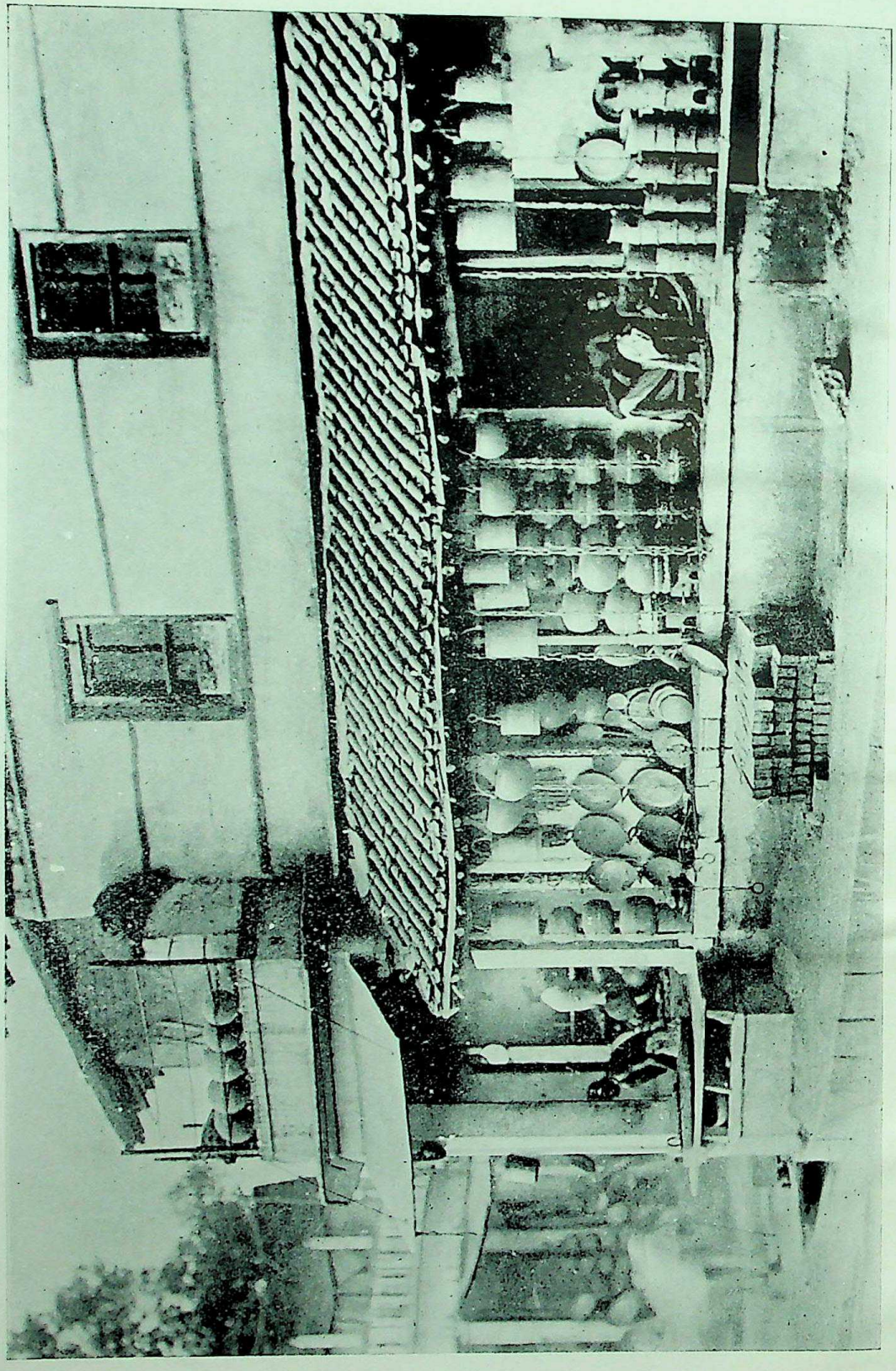

Ironware shops in Benares.

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A Monograph

ON

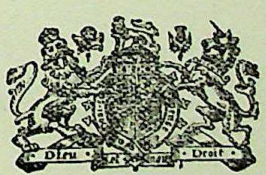
IRON AND STEEL WORK

IN THE

UNITED PROVINCES OF AGRA AND OUDH.

BY

W. E. J. DOBBS, I.C.S.



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PREFATORY NOTE.

THIS Monograph has been written in accordance with G. O. No. $\frac{3763}{I-136-06}$ of November 4th, 1906. In a subsequent order it was directed that the Monograph should deal only with indigenous manufactures.

No account, therefore, will here be found of those foundries or shops, worked by European methods, which already exist in most of the principal towns of these Provinces and in many of the lesser ones. Some of these are large industries and, obtaining pig iron from Bengal or elsewhere, make heavy castings of varied character: some confine themselves to miscellaneous lesser objects: a few may specialise, as for instance, Perfect's Sugar Mill factory at Bara Banki. Some are owned and managed by Europeans such as Crowley's and Luscombe's at Allahabad, or the Empire Engineering Works at Cawnpore: others as the Lucknow Iron Works, or the Shib Iron and Steel Works at Mughal Serai can boast they are "entirely an Indian Concern, owned by an Indian, managed by Indians, and worked with Indian labour."

The number of such concerns, big or little, has increased of late years and is bound to increase, perhaps very rapidly, in the near future. Sugar mills in the country, drain pipes, cast-iron railings, garden seats in town, to mention only a few objects, are becoming necessaries of life and can be made cheaply and well in this country. The methods and tools are European or of European type; but the workmen are Indian, and accordingly much of what is said of the ironworker in this Monograph is applicable to him whether he works in the European type of "shop" or in a little stall in the bazar.

When these firms are excluded, there remains very little iron work in the Provinces, except of the simplest kind. Artistic work is almost entirely wanting: in especial, wrought-iron with any claims to beauty is not to be found.

For such facts as I have gathered I wish to thank those gentlemen, Indian and European, who sent reports or answered queries. The photograph of the Arms collection of His Highness the Maharaja of Benares was kindly sent by Captain Vindeshwari Pershad Singh (A.-D.-C. to His Highness), who also contributed much information on the subject of weapons.

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A MONOGRAPH ON IRON AND STEEL WORK.

Chapter I.

WORKERS IN IRON AND STEEL.

Loha is the Hindustani word for "iron," and *lohar* is a worker in iron, a smith. The word *lohar*, however, is particularly applied to a caste whose traditional occupation is that of working in iron. In the United Provinces this caste was, in 1901, represented by 530,684 persons. Of these by far the greater number were Hindus: very few Musalman *lohars* are found in Oudh, the southern or the eastern parts of Agra: towards the north, they are more numerous—Meerut had 11,239 Musalman *lohars* and only 7,889 Hindus.

In this caste, as in many others, the majority of the members cannot find work in their traditional calling: hence it happens that there are only about 23,000 persons depending on iron work and not all of these are *lohars*. Most of the remainder, it may be supposed, are agriculturists: even of those who follow the trade of smith, very many till the soil also.

Mr. Crooke, in *Tribes and Castes of the North-Western Provinces and Oudh*, remarks of *lohars* that "the internal organization of the caste suggests that it is formed of many different elements and is, in the main, of occupational origin." The Hindu *lohars* are divided into nine *main* sub-castes; but as the Census returns show 736 Hindu and 114 Musalman sub-divisions, an enumeration here would be merely tedious. In pretensions and social standing these sub-castes vary from the Ojhas of the Central Doab, who plume themselves on a Brahmanical origin to the humbler *lohars* of Jaunsar Bawar, who appear to be of the Dom race.

In general, Hindu *lohars* ascribe their own origin to Visikarma, the great architect of the Universe—and (like Tubal Cain) the earliest of smiths. He is the patron deity of the caste; but many *lohars* have never heard of him and are content to worship the ordinary gods of their neighbours. All worship their anvils in the *Dasehra*.

The tradition of Muhammadan *lohars* is that Daud (David) was the inventor of iron-work and that iron miraculously became as wax in his hands. He sold articles of ironware to gain a living, and from his day

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iron has been in use. Accordingly they invoke him before beginning any task and burn incense in his honour on Thursday.

Whatever be the *lohar's* origin, his social position is a low one. He is a village menial, a Sudra, and iron is classed by Manu as one of the commodities which a Brahman or a Kshatrya must avoid. Nor is the Indian blacksmith harmonious or picturesque: there are no groups of horses waiting to be shod outside the smithy door, no burly man with leathern apron and musical sledge-hammer. The *lohar* would hardly become the romantic associations of an oriental Gretna Green, though he might give points to the barber.

The main business of the village smith is to make ploughshares and other implements of agriculture. He works in a humble shed, usually on the outskirts of the village. Against one wall there is an altar-like structure of clay, about thirty inches high, and projecting two or three feet from the wall. This is the furnace *(bhati)*. The fire, however, is not on top, but is in a hollow scooped out on a level with the floor and open towards the side at which the workman squats. Leading backwards or upwards through the earthen mass is an opening which serves as a flue: at the side is another small hole which admits the wind of the bellows.

The bellows *(dhaunkni)* is often the only article in the room which shows an innovation on the most primitive methods. It is generally of the type (though on a smaller scale) which is to be seen in the smithies of the United Kingdom. It is sometimes so arranged that the handle of the lever is directly over the smith's head, as he sits in front of his furnace, and a hanging home-made chain brings it within his reach and enables him to work the bellows without shifting his position.

The bellows is made of cowhide and the leather is bought from a *chamar* for about six rupees. The *lohar* himself adds the woodwork and sets it up.

The predecessor of this bellows was a double one, still often seen. Two leather cylinders, with wood fittings, resembling the two halves of an exaggerated concertina, are placed side by side on the floor. The operator squats in front of them and, by alternating pressure, deflates one while he expands the other. This type of bellows costs a little more than the other and is not so handy, as a separate person must be employed to work it; but it embodies the principle of a continuous

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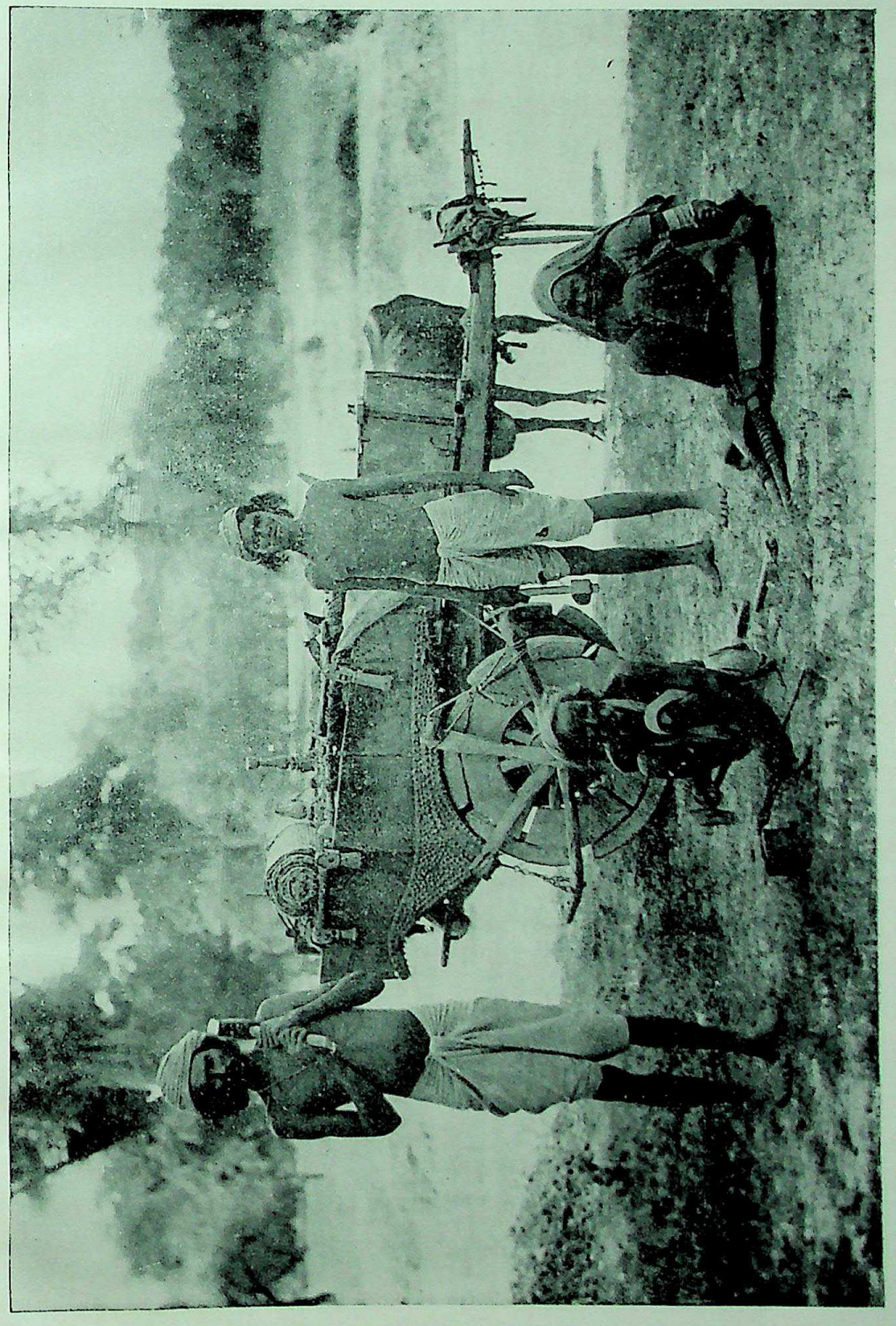

Wandering Smiths.

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blast, exemplified in the most modern type of bellows and in the fan which is now replacing the bellows in up-to-date workshops.

A still more ancient type of bellows—similar to one figured in Egyptian sculptures of over 1500 B.C.—is that of the Agariyas of Mirzapur, which also consists of two cylinders. It will be described in the next chapter. Another archaic type is the single *massak*, or goat-skin, which is alternately deflated and inflated: it is still occasionally found in use.

Near the smith, where he squats, is his anvil *(nihai)*. It is a small low lump of iron with a dome-shaped steel top. Its base is square and is inserted firmly in a circular section of a tree trunk, which is imbedded in the ground. The top of the anvil is only about six inches above the ground level. The *aran* is a slightly varied form of anvil and somewhat smaller, as is the *ikwai*, which has one or both ends tapering to a point. A section of an old rail meets the requirements of some of those who make small knives.

The smith heats his iron in the charcoal fire, the temperature of which he regulates by the application of water taken with a flat-ended stick *(kunchi)* out of an earthen vessel *(kundi)*. Among his other tools may be the *barma* (augur), *chheni* (chisel), *thappa*, *badian* or *dinari* (die), *sunba* (punch), *zambur* (pincers), *chimta* (tongs), *bhank* (vice), *sansi* or *saransi* (wrench), *parkar* (compass) and *reti* (file). The last-named is often the only tool he has not made himself. The *barma* usually employed is of the archaic type worked by bow *(kamani)* and cord *(tasma)*. The cord is stretched between the two ends of a bent stick, in the manner of a bowstring. A loop is made in it, and through the loop is inserted the handle of the augur. The workman presses the palm of his left hand on the top of the handle, to keep the augur vertical and steady; with his right hand he moves the bow, horizontally, backwards and forwards. This gives a rotatory motion to the augur.

The village *lohar* is paid in the old-fashioned way by an allowance of grain. The amount he obtains varies with each district and in different villages of the same district. His occupation is purely hereditary. There is no demand for training by outsiders: there are thousands of families of *lohars* by caste who by occupation are agriculturists pure and simple: and even the artizan usually has his fields and only devotes a fraction of his time to his craft. The ordinary smith

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is a handy man, and is often the village carpenter as well as smith, and may also be called in for such work as lining a well. In towns he occasionally displays considerable ingenuity, but is not usually of an inventive or artistic bent of mind. This may be partially due to the simple nature of his task and partly to his total lack of education: for the Census returns show that in 1901 less than one per cent. of the *lohar* caste in these Provinces was literate. Yet *lohars*, while adhering to their traditional calling, have the possibilities of a greater future than any other menial caste. For, as is remarked in the last Census Report, the use of iron vessels for domestic purposes is likely to increase—the *kumhar's* poison will be the *lohar's* meat: and, secondly, the increasing use of machinery in towns and even villages will necessitate the employment of a great company of smiths and fitters. One of the pressing industrial problems of the day is, how to meet the large and increasing demand for competent mechanics.

In the towns the craft is less exclusive than in the villages: in most large workshops are to be found numbers of Hindu operatives who are not *lohars*, and, even outside the districts where they form a distinct class, Muhammadan ironworkers are numerous. In towns, also, a sort of apprenticeship system is often found: boys are employed on the simpler work at a couple of rupees a month, and their pay is gradually increased according to their proficiency. In factories, children under 14 are admitted only with their parents, yet, apart from these, there are often found very useful workmen "trained on the premises." These outsiders sometimes learn at a disadvantage, for workmen are unwilling to teach the best results of their experience except to their own sons.

A good mechanic in the European type of shop can earn twenty or twenty-five rupees a month or even more; but employers complain of the difficulty of finding competent men. They are drawn away to Calcutta and elsewhere by the prospect of better wages: it is hard to replace them and the desire of well-paid artizans to "educate" their sons, rather than hand on the torch of mechanical skill, has a further bad effect on the supply. A certain number of *lohars* come into the towns with rudimentary knowledge they have acquired in the village smithy: they furnish some of the best material, but have to be trained anew to a certain extent, as in the villages they work with charcoal; while in the towns, where coal is used in the furnaces, they have to deal with a different set of temperatures. An intelligent

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village *lohar*, it is said, can in three years become a good workshop hand. There are possibilities in the village smithies as recruiting grounds, if only the blacksmith can be induced to pass a succession of learners through his hands instead of confining his instruction to his own family; members of his caste can be found in plenty. Thus might partly be met the need for elementary training: the necessity for the higher technical instruction remains. One of its chief objects must be to teach accuracy: for even good mechanics, like other Indian workmen, are blind to the importance of accurate work, and therefore to a great extent untrustworthy.

In the Western districts and in Bundelkhand are found interesting gangs of wandering smiths, who at certain seasons migrate from Rajputana. Like the English tinkers, they wander about from place to place with their families, goods, and chattels, in carts of rather quaint appearance: strong solid wheels of wood, sometimes strengthened with iron, support a body whose sides are narrower at the top than below. These people who claim to be Rajputs have a tradition that their ancestors were settled at Chitore When the Moghals sacked that city, they took to a wandering life, and vowed that they would settle nowhere else but would make weapons of war for the people of the land till Chitore should recover its former glory. True to their vow they have never settled: but Pax Britannica, with its Arms Act, has forced them to literally beat out ploughshares instead of swords, and they are now regarded as specially expert at working up old iron into serviceable tools. Their charges are moderate and villagers look for their coming. "These people," says Mr. Crooke, "probably represent the most primitive form of workers in iron." Their women work as hard as the men.

Besides the ordinary *lohar*, there is found in many or most large cities a certain number of men who follow the occupation of *saipalgar* or metal-polisher. Sometimes a man combines both occupations, he makes knives and polishes them. Oftener the *saiqalgar* is a specialist. In the old days, he, doubtless, found a good deal of employment in polishing swords: there is a man in Lucknow who still does this task for the Museum authorities. Nowadays *saiqalgars* are found where cutlery is made, as in Meerut and Shahjahanpur. Sherring, in his book on castes, says that this tradesman is called Barhiya or Sandhara when a Hindu. Dr. Hoey, however, raises a *saiqalgar* to the dignity of an armourer, and says that the Bariya is a

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knife-grinder, and a trader of no worth. In these days the distinction is of small importance as armourers have died out.

Another specialist is the damascener of Rampur. At the present day only one family engages in this industry. Its members are Khattris and say that their ancestors came from Lahore.

Quite distinct from the *lohar* is the Agariya of Mirzapur. This race inhabits the tract across the Son and is devoted to smelting and iron work: in numbers it is not above 500. It is of Dravidian origin and the *lohar* owns no connection with it. Sherring probably refers to this caste under another name when he speaks of the Odhiyas, a caste of iron smelters and workers which "inhabits the Allahabad Province." Apparently they are not connected with the tribe of Doms known as Agaris who dwelt in Patti Agari in Naini Tal district and whose profession was till recently that of miners.

Finally, mention must be made of the man who puts the products of the town *lohar* on the market. Sometimes the *lohar* himself has a stall in the bazar: sometimes he runs one as the man of a *bania*. Very often, a man of the trading classes keeps a shop where the various products of the native smith are sold: and in the north of the United Provinces there is a special class of *banias* known as *lohiyas*, who engage in this trade.

There is a lack of interesting lore in connection with iron and iron work. There is hardly a popular proverb on the subject save perhaps

Ek lohar ki, sau sunar ki—"One blow of a blacksmith's hammer avails one hundred of a goldsmith's."

The following expressions have a certain currency:—

Loha ke chane chabana—"To chew iron gram" ("to cut through adamant").

Lohe ko loha marta hai—"Iron strikes iron." ("Diamond cuts diamond.")

Thanda loha garm lohe ko kat ta hai—"Cold iron cuts warm." ("Patience prevails.")

Bhala kahin thande lohe bhi pitne se durust hote hain—"Cold iron cannot be straightened by hammering." ("Ploughing the sand.")

In contrast to the English superstition it is regarded as unlucky to meet a horseshoe. Muhammadans believe that they can injure an enemy by writing his name on a horseshoe and then putting it in the fire. *(Nal dar atish.)* Among Hindus, it is of good omen to

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place iron in the form of a pig in the foundations of a house. Iron, further, is supposed to find favour with Saturn, and an iron image of Saturn given (with other articles) to a *fakir* averts the planet's evil influence. In marriage ceremonies iron rings and bracelets are given to the bride and bridegroom, and children are sometimes given a piece of iron to keep them from harm.

One way of producing gold is to stick a sword upright in the ground: to transmute the metal, all that is needed is a stroke of lightning. A real "philosopher's stone" is said to lie in the Krituwa Tank at Mahoba, but its identity is unknown.

The Agariyas of Mirzapur, it is said, should they discover a nugget of gold in their iron ore, take to their heels without the nugget, fearing, it may be assumed, to rob the "*genius loci*." A specific instance of this practice would be very interesting and possibly profitable to the observer.

Chapter II.

SUPPLY OF IRON.

At the present time nearly all the iron used in these provinces is obtained originally from Calcutta and Bombay. Thus in 1905-06, nearly nine lakhs of maunds of wrought-iron were imported: of this nearly five and a half lakhs came from Calcutta and over two lakhs from Bombay. These two ports also send the largest contributions in the way of cast-iron, unwrought iron and manufactured articles. In view of possible future developments, it is interesting to note that at the present time the imports of iron from the Central Provinces are almost negligible in quantity.

The iron is imported in the ordinary forms of bar iron, sheet iron, etc. The vernacular name applied to bar iron is *sikh*: sheet iron is known as *chaddar*. The thin strips of iron used in binding packing cases, etc., is called *patti*: and according to Dr. Hoey, a thicker kind of this seems to have been known as *pattiya*. Dr. Hoey also mentions certain kinds of *desi loha*, imported from Cawnpore and used at Lucknow in 1878. Such were *gadra tawa*, *danda*, *chandia* and *chir*. In this case *desi loha* may refer to Central Indian iron, for in those days Cawnpore was a considerable emporium for the Central Indian as well as for the European metal. Possibly it only means iron "made up" at Cawnpore, *gadra tawa* simply referring to iron for making griddles, etc., while *danda* is a translation of bar iron. In the same way

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there is now sold at Bareilly and probably elsewhere iron called *degchi loha*, that is, scrap iron worked into a form suitable for the manufactures of *degs*, or caldrons.

The soft iron, bought in small bars, commonly used by the ordinary *lohar*, is almost invariably called by him *sulis*. This word is thought by some people to be a corruption of Swedish. But that the iron so called is *not* Swedish iron is shown by its price, sometimes only two annas a seer. Nearly all the bar iron used by village *lohars* and the small artizans in the town is scrap iron worked up. The railway workshops at Cawnpore and elsewhere place a large amount of scrap iron on the market, and it is sometimes sold at as low a rate as Re. 1-4-0 a ton.

Of the imported iron, a good deal is Belgian: and cheap German steel is also introduced. The ordinary name for steel of foreign origin is *ispat*. In the old days, Indian steel was renowned under the name of *kheri*, but there are no traces of its recent manufacture in these Provinces.

In the times when supplies of iron could not be drawn from Europe, this metal was obtained, in the North, from the hills of what is now the Kumaun Division and from Nepal and in the South from Lalitpur, Mirzapur and Central India. The smelting industry still survives precariously in both the North and South of the Provinces. But it is rapidly dying out in its primitive form and so far no attempt has been made to apply European methods to the reduction of the rich ores in the Southern districts. In Kumaun, however, the possibilities of establishing an iron industry were recognized. Full accounts of this unsuccessful enterprise are easily available in the Gazetteers and elsewhere: and we cannot do better than quote from Mr. Nevill's summary:—

"In patti Agar there are several mines that have been worked within late years, chiefly those at Lusgani, Nathua Khan Gulla and Satbanga. In Ramgarh, too, many mines were worked as late as 1884, but they are now all abandoned. The mining industry was very flourishing at the commencement of British rule, and the Ramgarh mines were leased at a nominal rent to the headman of the Agaris, who till 1826 controlled all the iron mines of Kumaun. It received its first check in 1883, when the miners emigrated from Ramgarh to Khetsari in Pali of Almora, and the business never afterwards recovered its early importance. The existence of iron soon attracted the attention

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of Government, and in 1856 the Directors sent out a Mr. Sowerby and a large staff of mining assistants to carry on the smelting of iron on account of Government in the interior. The fact was soon established that iron of an excellent quality could be manufactured at rates below the cost of iron imported from England, and a number of private individuals, under the style of Davis & Co., were permitted to undertake operations for the same purpose in other parts of the lower hills."

"The avowed object of the Government enterprise was to induce private companies to work by demonstrating the financial and physical possibility of carrying on iron works as a remunerative industry in this Province. Messrs. Davis & Co., proposed to take over the tract between the Dabka and the Bhakra, and their proposals were accepted with an assurance that they might proceed in confidence to make their arrangements, as Government would grant the lease sought. They therefore took over the Khurpa Tal works in the rains of 1858, and paid their cost price in 1863. This company also erected buildings at Kaladhungi at a cost of Rs. 1,25,000. On the failure of the Government works at Dechauri, Colonel Drummond offered to take them over at a valuation. These works were given over to Drummond & Co., who paid the capital under agreement into the treasury in 1861. The forest rules were relaxed in favour of both companies, so as to allow them entire control over the fuel supplies, and eventually, in November 1862, both companies were amalgamated under the title of the North of India Kumaun Iron Works Company (Limited). Soon after the formation of the Company instructions were received from the Secretary of State to construct a tramway to Khurja on the East Indian Railway chiefly, it would appear, to afford an outlet for the iron manufactures of Kumaun. The tramway was to be laid with cast iron rails manufactured at Dechauri, and the Company lost no time in making several thousand maunds of pig iron. Before the rails were made, however, the Government announced its determination not to undertake this line itself, but to hand its construction over to the Oudh and Rohilkhand Railway. It was essential to the success of the enterprise that some such outlet should exist, and the Company accordingly determined to close its works for a time and await the opening of the line."

"A license was granted by Government, but unfortunately it was not executed till too late. The agreement contained several conditions binding the Company to produce a specified amount of iron each

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year, to reforest the area cut down for fuel, and among other stipulations to pay a fixed rent and a royalty on every ton of iron produced; the capital was to be paid up before the execution of the deed and the full value of the works at Dechauri, Ramgarh and Khurpa Tal paid in four instalments, the last falling due on the 1st of September 1865. The penalty for failure to comply with these conditions was forfeiture of the property. The purchase-money of Khurpa Tal was alone paid up, but Government suspended the forfeiture clause in 1868. The license was not sent up from Calcutta till June 1864, and in fact was not prepared for signature until after the suspension of the work by the Company, and it was then never signed. The capital was expended and the concern was wound up in 1864. A later attempt was made to resuscitate the Company, but without success, and the enterprise was abandoned in 1876. Government then took over the works for three years, but also failed, and on the conclusion of the lease reverted to the old idea of pushing the manufacture with private capital; but this, too, was of no effect, as no one was found to take up the work of the Company. Undoubtedly these works had not a fair trial—an opinion which was held by Sir Henry Ramsay, who considered that if properly started they would pay their way readily. The fuel difficulty could not have been felt for many years at Dechauri and Kaladhungi, although at Ramgarh the works necessarily failed on account of the distance of the forest and the difficulty of carrying fuel. All the works are now in ruins, and all hope of renewing the industry has been abandoned."

On general grounds it would seem that any large development of the industry on the basis of charcoal as fuel is impossible. But, it may be suggested, that if the Government undertook the construction of a tramway, such as that proposed so many years ago, to Khurja, or other suitable point in East Indian Railway, the demand for rails and sleepers would make a smelting industry pay for some time: after that, when the fuel difficulty began to be felt, the plant might be transferred from the hills, the ore imported to the plains by the new tramway, and, at some suitable spot, treated with the aid of Bengal coal.

For the present, the smelting industry is extinct in Naini Tal: in Garhwal it feebly survives. In that district there are six iron mines paying an annual royalty of Rs. 56; the lessees are zamindars who sublet the mines to *lohars*, and one man is said to get from Rs. 60 to Rs. 80 for the Jai Tal and Hal mines, for which he pays Rs. 20

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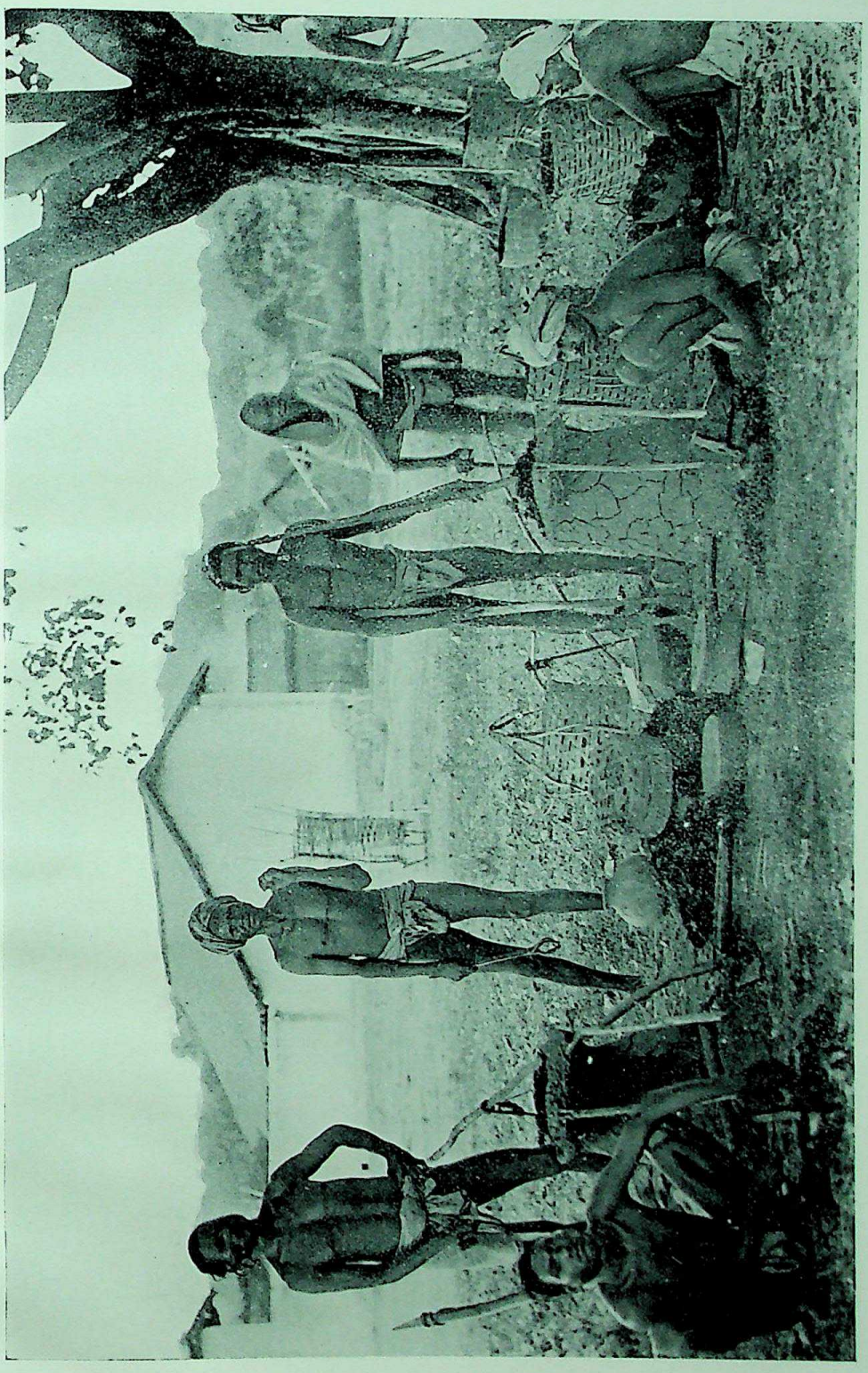

Aheria Smelters.

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to Government. In 1906, it is estimated that the mines produced only $3\frac{1}{2}$ tons of ore. The great majority of *lohars* here, as elsewhere, use imported iron, but a few who receive grain payments, continue to employ the methods of their ancestors. It is estimated that to produce a seer of iron in this way costs seven annas: whereas it is possible to buy imported *sulis* for less than three annas a seer. It is said, however, that the iron of local manufacture is much more durable.

Restrictions on cutting fuel, and especially the prohibition of cutting the chir tree, whose charcoal was regarded as especially effective in smelting, have placed a further check on the operations of the native smelters. The following description of the method of mining and smelting in the Himalayas, culled from an old Gazetteer, is of little more than antiquarian interest; but the system may be compared with that found in Bundelkhand and Mirzapur.

The mines were low narrow galleries made in the face of the hill. The water was passed out in buckets when the slight outward slope of the gallery did not enable it to run off. Light was provided by pine torches and the simplest tools were used. Boys dragged out the ore in skin barrows: and it was then pulverised by women, and dressed with a sieve, in order to remove impurities: after which it was washed by women in running water.

"The furnace is very simple, and is made of common stone and clay faced with slabs of quartszoze schist, luted with a compost of chaff and clay. It is about $3\frac{1}{4}'$ long by $2\frac{1}{4}'$ broad with an ash-pit about six inches square, all of which are built inside a house about 12′ by 14′ of which the roof is composed of planks. The operation of smelting takes about $28\frac{1}{2}$ hours, during which time the fire is kept up, and after that the facing slabs and luting require renewal. The implements used are a crowbar, poker, shovel and a pair of buffalo hides, dressed whole, to form the bellows, the neck of which forms the nozzle and the buttock the valve for the ingress of air. The hides for making them are worth Rs. 12 apiece. The furnace being freshly luted, the ash-pit is filled with charcoal dust and chaff, and a fire being lit, six baskets of iron ore, each containing about 30 seers are placed round the fire. The blast is then commenced, one bellows being inflated while the other is undergoing depletion. In about half an hour the slag commences to flow from the flosshole, which is kept open by a poker. In about two hours more, the ore having subsided considerably, two more baskets of ore and a corresponding supply of charcoal is given with a new luting

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for the bellows nozzle. In another two hours, this having also subsided, the charge is deemed ready. The fire is then raked out through the flosshole, and the charge consisting of a pasty mass called *phaulka* or *jhanj* is shoved out with a crowbar by the smelter. The same operation is repeated until seven blooms are obtained consuming thirty-eight baskets of ore, thirty-one of which are converted into seven blooms, and the remainder, comprising the partially roasted ore, become the property of the smelter. The charcoal consumed weighs 340 seers or a little more than the seven blooms which weigh 327 seers, or about one-third of the ore expended. Each bloom consists of three qualities of metal, all intermixed with earthy particles. These are kept separate and are broken into small pieces before being sent to the Khatauniya or refiner. The furnace of the refiner is smaller than that of the smelter and the implements required are a pincer, poker, two or three sledge-hammers, an anvil and bellows. The fire being lit, a mixture of one-sixth of first quality, one-sixth of second quality and the remaining two-thirds of third quality, in all about six seers of bloom metal, is placed on the hearth opposite the bellows, with the larger pieces nearest the fire. The blast having commenced, in a quarter of an hour the slag begins to flow and in another quarter of an hour the metal, now a porous pasty mass, is taken out of the fire and subjected to the blows of two or more sledge-hammers: the blows being slight at first, to prevent the metal flying in pieces, but as it becomes more solid, they are given with the full force of the workmen. From "the hammered mass" is wrought a small bar weighing one and a quarter seer, and six seers of charcoal have been used in its formation. This bar is now fit for the market and is called by the workman *phala*, but by the plains people *pain*." The refiner and smelter use different classes of charcoal.

"The refiner class is subdivided into another called Bhadeliya, who instead of making the iron into bars manufacture it at once into cooking utensils. From 930 seers of ore come 82 seers of marketable iron, or 8·8 per cent. For every seer of iron, 8·2 seers of charcoal are required."

We now come to the iron produced in the South of the Province.

The South of Lalitpur abounds in iron ore of different qualities: in some places, as Solda, it is a rich and pure hæmatite. Mines have been worked here for generations, probably for many centuries. So late as 1871 there were, according to the Settlement Report, 53 furnaces at work, the average annual payment to the Forest Department being

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five rupees. From Solda iron was largely exported to Saugor and the South. There are now only six furnaces in the whole tract: four of these are at Solda, and even there the trade is local. Were it not that Solda is forty miles from a Railway Station, the industry would be quite extinct.

The smelters at Solda are by caste *lohars*. They obtain the ore from a mine about one and a half miles distant, it is entered by a sloping shaft which is about forty yards in length. The solitary miner is of the jungle tribe of Sheriyas and is assisted by his boys. A heavy mallet *(jhumra)*, a small pick-axe and a couple of wedges are his tools, and the ore is carried in baskets to the sheds near the village where are the furnaces.

The furnace is formed like a mud wall three feet high, about four feet long, and a couple of feet thick. The actual receptacle for the fuel and ore is in the middle of this. It is circular and has a diameter of a little over a foot. It is open at the top. At each side of the opening is a space, in one of which is kept the pounded ore, in the other charcoal. The furnace has two openings at the bottom, one a venthole for the slag, in front: the other hole is at the back, to admit the air from the bellows. The blast is introduced through a partially baked earthen nozzle or *tuyére* made locally and called *nariya*.

The furnace is charged by putting in a basketful of charcoal: pounded ore is then put in, and more charcoal; as the first charge subsides, more ore and charcoal are added. In all about twenty-five seers of charcoal and twelve of ore are put in for one operation. The bellows is of the double type and is worked by a man sitting behind the furnace on a small stool. He is protected from the flame, which leaps from the top of the furnace, by a sloping screen. The blast is kept up continuously, the slag meanwhile running off through the hole in front. The conglomeration of the iron is aided with a long bar called *girdalo*, and after about three hours, a spongy mass weighing about six seers has formed at the bottom of the furnace. It is extracted through the top with a pair of long tongs, immediately cleft in two, and left in the open air to cool.

The iron so obtained is far from pure. Its further refining takes place in a smaller furnace similar to the ordinary *lohar's* forge save that it has a longer flue and a venthole for slag. When heated in this, the pig iron loses half its weight or more, but is then pure enough for use and can be immediately wrought into ploughshares, etc. Most

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of the village *lohars* in this neighbourhood perform the second process themselves. The unrefined "pig" is called *dhariya* and is sold at two or three pice a seer: it takes many hours to make it into iron ready for use, which is sold at from five to eight seers to the rupee. The slag is called *mel* and an iron hoop called *tanni* is used for extracting it.

A noticeable feature of the smelting is that no lime-stone or other flux is put in the furnace to aid in the extraction of silicates and other impurities. Were the ore less pure (it contains over 70 per cent. of iron) its smelting under these conditions would be almost impossible. As it is, there is evidently a great waste of metal, as out of a given quantity of ore there results eventually only about 25 per cent. of wrought-iron. The smelters say that the waste is greater in the hot weather, but the reason for this is not clear.

The expenses of these *lohars* are mostly in the matter of charcoal. For each furnace seven rupees yearly is paid to the Forest Department. This gives a right to extract ore, and to cut charcoal in five acres of jungle. The cost of mining is very little—four annas a day to the miner, whose services are not required continuously. It is estimated that each basket of charcoal costs the *lohars* five pies in wages—so that the charcoal required for producing five seers of *dhariya* costs about two annas. The *dhariya*, if sold at three pice a seer, will bring in about four annas. This does not leave much margin for profit—even though the furnace can turn out five charges a day.

In a very few years there will be no smelting at Solda. It will be increasingly difficult to obtain charcoal near at hand: and foreign iron will entirely replace that now used. Nor is there any chance that the rich ores of the district will be properly exploited while the railway is so far off.

The other Southern district in which smelting is carried on is Mirzapur. There, in the tract across the Son, there is a small Dravidian tribe, the Agariyas, whose proper occupation is smelting. At several places in Dudhi Elaka, ore *(dhan)* is obtained. It is apparently brown hæmatite. The process used by the Agariyas is fully described by Crooke and is similar to that found in Lalitpur. The furnaces, however,—"generally erected under some old tamarind or other shady tree on the outskirts of a village, or under sheds in a hamlet"—are of a tapering form and the internal diameter is only six inches. The bellows used are very primitive: they "consist of basins loosely covered with leather in the centre of which is a valve. Strings

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attached to these leather covers are connected with a rude form of springs which are simply made by planting bamboos or young trees into the ground in a sloping direction. The weight of the operator, or pair of operators, is alternately thrown from one drum to the other, the heels acting at each depression as stoppers to the valves. The blast is conveyed to the furnace by a pair of hollow bamboos, and has to be kept up steadily without intermission for from six to eight hours." The molten iron when extracted is immediately hammered and is sold at about two annas a seer.

The general subject of iron smelting in India was discussed about seventy years ago by Captain J. Campbell in the "Calcutta Journal of Natural History" (Volume III, page 386). It is interesting to compare the change of conditions. "English iron," he wrote, "is not used in land in Southern India in consequence of the great expense of land carriage and from the same cause, it is probable, that in Northern India also the only iron used is that made upon the spot." He describes the process of smelting and remarks that it appears to be "very much the same from the Himalayas down to Cape Comorin." Charcoal in those days might be made at about fifty pounds for an anna: and the unrefined iron or "pig" which resulted from the first smelting was sometimes sold at two annas for five seers. As to the quality of Indian iron he remarks: "I consider the worst I have ever seen to be as good as the best English iron and that its supposed defects arise from it almost always containing a considerable portion of steel." It is somewhat remarkable that nowhere in India do the natives appear to have been acquainted with the use of a flux in smelting, though in places, as the Kashi Hills, the furnaces were within reach of plenty of limestone; in this respect, they are behind a very interesting community of smelters in West Africa whose methods were recently examined and described. It is in this, also, that the only essential difference exists from the process of smelting employed in the United Kingdom as late as the 17th Century.

Chapter III.

WEAPONS OF WAR AND THE CHASE.

The manufacture of arms must have been of some importance in these Provinces before the days of British rule and Arms Acts. The various chiefs and their retainers had to be provided with weapons and probably every town and castle of importance had its armourers of

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sorts. But of most places the same might be said as of Lucknow: for (to quote the words of the Deputy Commissioner) "the slight evidence which is given on this subject points to the fact that the manufacture of arms in Lucknow in Shahi days was quite unimportant and the work was little more than part of the ordinary *lohar's* craft."

It is said that Agra had some repute for the manufacture of chain armour and of weapons of war; but Delhi swords, made of imported steel *(faulad)*, were held in the highest regard, those of Babar Khan being famous above the rest.

Collectors of Indian arms, when they attempt any classification at all, divide swords into eleven classes, under the three main heads of Vilayti (imported), Asils (the renowned blades of Gujrat) and Khanasaz (of domestic manufacture). East of Delhi there is no place noted for swords made of imported steel; but weapons of the Indian material were produced in many districts. Pihani in the Hardoi district turned out excellent swords of the kind known as Tegas, with engraved blades, up to a generation ago, and the son of the last swordmaker is still living. Pihani blades bear a trademark somewhat resembling a grenade. Good swords were also made at Balla (Rae Bareli); Khusrupur; Basi (Muzaffarnagar); Bindi (Moradabad); Shahjahanpur and Rampur. The Mahmudabad collection contains weapons from Cawnpore and Sotela in Bara Banki.

The Indian steel used for sword blades is known as *kheri* or *jhurkutia* and has a great reputation. It is apparently identical with *wootz*, the manufacture of which is described by writers on iron and steel. It was obtained by a double process of smelting with charcoal; but at the present day its manufacture is extinct in the United Provinces. The manufacture of a sword from this substance is described as follows:—"The sword was first shaped out of *kheri* and different designs intended for reflection on the surface of the sword were engraved on it. These indentations were then filled with certain ingredients (including silver, copper, arsenic, sulphur and saltpetre). Two other pieces of soft iron of exactly the same dimension and shape were then constructed and made to cover the sword on both sides. The whole was then thoroughly heated, beaten into one, and polished. The blade was afterwards strongly heated and dipped in cold water." "Nearly all the swords manufactured in this country were made on the above lines. Soft iron was always associated with hard iron in making

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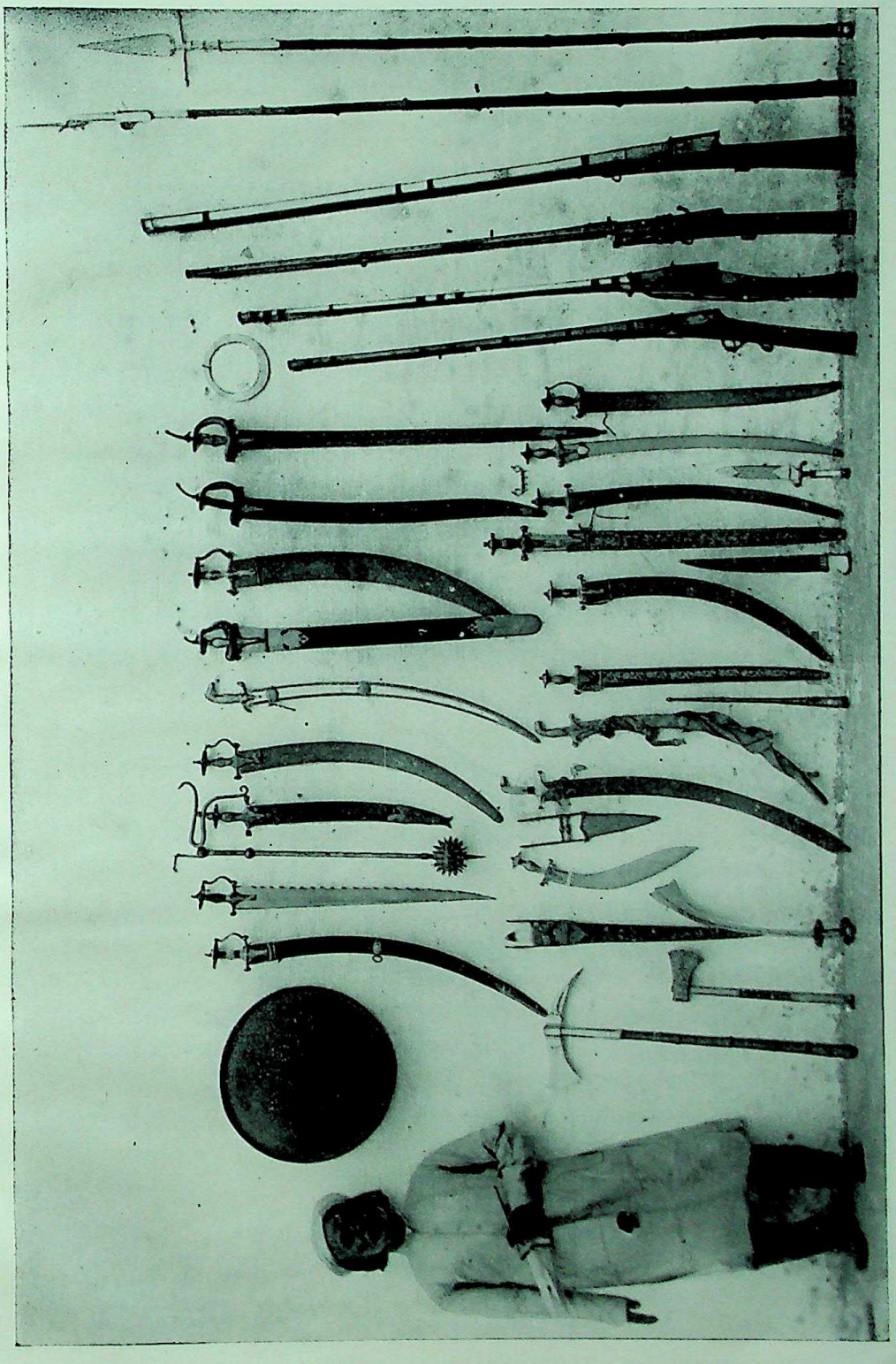

Collection of arms, belonging to H. H. the Maharajah of Benares.

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good swords." Swords made in this way are called *sakela* and are considered very safe and reliable weapons."

The veins on blades thus made are known as *jouhars* and are of various designs: the beauty of the sword is sometimes further enhanced by its being gilt or silvered, and the handles in every case are profusely ornamented.

Swords made of imported steel *(faulad)* were tempered not in water, but in oil. Even foreign steel blades were sometimes supported on one side by soft iron, to make them less brittle and such swords are known as *chup*.

At the present day there are not more than half a dozen sword-makers in the Provinces, inclusive of the two or three at Rampur and of the Maharaja of Benares' armourer. At Bareilly there are two men who hold licenses, but their services are in demand for repairs only. Even at Rampur, the Nawab has checked the manufacture of weapons. The workmen at Rampur can make very neat swordsticks *(gupti)*. The blade is of imported steel, and is enclosed in a neat case of black bamboo sometimes ornamented with a silver handle. Such a sword takes two men four days to make, and the polishing takes another day.

Daggers *(katars)*, Maces, and Discs *(chakras)* are other weapons which were formerly manufactured. Shahjahanpur daggers had a good reputation. The *kukri* so often seen in these Provinces is sometimes imported from Nepal and is made of *kheri*, but there are several households of *lohars* who make them with foreign steel at Almora. Thence they are brought to Ranikhet, Naini Tal and elsewhere, and sold to Europeans. The spear *(ballam)* is still made for purposes of sport.

We now come to firearms. The cannons employed formerly were either Jezails (monster matchlocks) or those of the ordinary type. The latter were either cast or made in two semi-circular portions which were then firmly bound together. Such cannons are known to have been made at Lucknow and at Ramnagar (Benares): and doubtless their construction was not confined to these two places.

The manufacture of matchlocks survived into very recent times: and Talbahat, in Lalitpur, one of the places that longest preserved a reputation for making them, exhibited one at the Calcutta International Exhibition in 1883. A generation earlier, Dhampur and Nagina in the Bijnor district attained distinction in the same line. "Matchlocks

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made to order at Dhampur and Nagina were exhibited at the Paris Exhibition of 1867, where some obtained a prize of 750 francs and others were readily sold." Nagina, indeed, had at one time a considerable name for the manufacture of gun barrels and is described in Davidson's travels as "the Birmingham of Upper India." Of other places where good matchlocks were made may be mentioned Mahoba, Agori (in Mirzapur), Rampur, Lucknow, Najibabad, Khurrampur, Shahjahanpur, Bareilly and Ramnagar. According to a *lohar* at Talbahat, it took a month to make a matchlock and for the first eight days six men were at work on it. The finished article was sold for 25 rupees, which gave the maker a profit of about five rupees only. Up to a generation ago, such a weapon formed part of the equipment of every Bundela Thakur and matchlocks are still made in the Native States adjoining Bundelkhand districts.

The barrels of Indian firearms were sometimes ornamented in the same manner as sword blades, with *jouhars* or veins. The stocks were variously adorned and were fastened to the barrel with strings made out of a certain kind of cocoon or out of the veins of animals.

The ability of clever *lohars* is strikingly shown in their power of copying good European firearms of modern type. Weapons almost indistinguishable from the originals have been turned out at Rampur and Bareilly. Thakur Prasad, a workman of the Maharaja of Benares, is said to have lately made a double-barrelled rifle of great power and accuracy and of fine finish.

In the absence of modern tools the method of work is necessarily somewhat primitive. A gunmaker at Rampur states that his first step is to make a strip of iron half an inch thick and half an inch broad. This is twisted round a rod and then forged into one piece. The tube is then bored out several times with a *salai* of which six sizes are used. The last boring is done with oil. The labour is considerable and four men are kept at work for three weeks. The finishing, etc., done by one man takes some weeks longer. Iron *hookah* tubes are made in the same way as gun barrels.

A line can hardly be drawn between weapons of war and those of the chase. The iron arrow-heads still made by the aboriginal tribes of Mirzapur are nowadays not destined for human bodies. Hunting knives of good quality were formerly made in Lalitpur. Collections of arms include sometimes very ingenious weapons for the destruction of game : for example, a spear with a pistol attached, and

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so arranged that the pistol is discharged on the spear touching the body of the intended victim. Another curious weapon is an automatic claw fixed on the end of a spear handle for clutching hares, jackals, etc.: a larger size is intended for gripping obstreperous elephants, but its effectiveness may be doubted. Indeed, it is not clear (from the description received) whether the elephant is to be seized by his trunk, by his tail or by an uplifted paw.

For the ornamentation of weapons, pure *répoussé* is very common: or the surface of the design may be gilt or silvered. A combination of gold and silver scroll work is known as *Ganga Jamna*. If the design is first engraved and then filled in with the gold or silver, the work is called *tahnishan*. In *zarnishan* (or *koft*) the design is slightly raised before being gilt or silvered. A third style of ornamentation is *jarbuland:* in this the design, gilt or silvered, stands in bold relief. These technical distinctions, however, are known only to connoisseurs and experts: and the word *koft* is generally applied to the inlaying of gold or silver, or damascening, such as it is, now done in Rampur city.

There are now three or four workmen at Rampur who ply this trade. They are Khattris, and profess to belong to a family that migrated from Lahore. The objects which they ornament are mostly handles *(sham)* for bamboo walking sticks and *sarotas*. But *hookah* bowls, gun barrels, etc., occasionally come under their hand: good specimens of Rampur work are to be seen in the Lucknow museum.

The article to be damascened is obtained from a *lohar*. The first process is to prepare the plain metal for the reception of the inlay. This is called *kodai*. The surface is roughened with a hammer and small chisel, and a small tool called the *chirna* is also used for scratching the lines.

The next step is the application of the gold or silver wire. Silver wire, finely drawn, costs about Re. 1-6-0 a tola (four annas being the cost of drawing it): while gold thread costs about 30 rupees a tola. The workman takes the wire in his left hand and lays one end of it on the roughened metal surface. In his right hand he holds a small tool *(salai)*, pointed at one end and flattened at the other. By means of this, he makes a tiny coil of wire, places it over the proper spot, and hammers it into the iron with a small hammer. If the wire is to form a small circle in the pattern, it is wound round the pointed end of the *salai*, so as to leave a loop.

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When all the wire has been put on, the article is put in a charcoal fire for five or ten minutes: it is not allowed to get red hot. When withdrawn and while still hot, it is rubbed hard with a *gotna*, a polished pencil of very hard steel, in a wooden handle. There is also a *gotna* made in the form of a curved blade, for reaching into angles. While being rubbed with the *gotna* the article is kept in position, on a small wooden stand, by a pair of tongs.

The result of the process is a regular pattern of gold or silver on the black metal; and the effect is often very pleasing. One of the nicest pieces of work recently done was a *hookah* tube: a design about three-fourths of an inch broad, laid on spirally, relieved the heaviness of the metal surface and gave it a most finished appearance.

The workers seem to have two or three standard designs, but are not very clear as to their classification. *Lehr* is where the work is in lines; the circular pieces of inlay, more or less floral in arrangement, are called *phul*, and the design composed of them is in general termed *bel*, with variations such as *golbel* and *aribel*, according to the arrangement of the loops or petals. There is also shown what they call *bendi* or cypress tree pattern. No samplar is kept, nor is the design drawn first, as a rule. The standard figures "*dil men hai*" —("exist in the mind.") Sometimes a customer wants a particular design and furnishes a sketch of it on paper.

The artizans do "piece work." To give an idea of their pay and the cost of the work we may take the case of a *hookah* bowl. The *lohar* who made the bowl did not get more than five rupees for it. The purchaser brought it to the damascener, with a written pattern. He had to provide about eight rupees worth of silver wire: and to give a similar sum to the workman for inlaying it. The work took twenty days.

For damascening a sword handle, the man gets a rupee. It takes him four days to do the job: and a rupee's worth of silver is used.

Damascened articles are, therefore, very cheap, considering the skilled and more or less artistic labour involved; but the industry, already so diminutive, is dying out. The son of one of the present workmen has learnt the trade, but appears more likely to become a clerk than an artizan.

In this chapter mention may be made of the elephant goad or *ankus*, which has a certain affinity with martial weapons—if only on account of the wound it inflicts on *hathi's* head. The ordinary

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elephant goad is a very prosaic instrument made of ordinary soft iron and ornamented in a rough way. *Mahouts* call the crook *hansiya*, the point *sursa* and the handle *dand*. To make an ordinary *ankus* takes little skill, and the weapon costs only about Re. 1-8-0. Yet in various districts there are particular *lohars* who make a speciality of this instrument. Shahjahanpur and Kirwi used to export a few and Shaikhupur in Meerut is a village once famous for its ornamental *ankus*. At the present day the Nawab of Rampur's goads come from Kashipur in the Tarai.

Kipling, in his "Jungle Book," has taught us the possibilities of the *ankus* from an artistic point of view: and it is a fact that these instruments are sometimes lavishly ornamented. That used by the Maharaja of Benares on State occasions is richly jewelled and worth thousands of rupees.

Chapter IV.

CUTLERY.

Some of the weapons referred to in the last chapter are of the nature of cutlery. This chapter relates only to the smaller articles.

The most typically Indian of these is the *sarota* or betel-nut cutter. It is a lever on the nutcracker principle; but its essential portion is a broad blade at the fulcrum end of one of the "arms." *Sarotas* are very common and are necessaries in households of even very small means and they are very various in make and value. Rough, ugly betel-nut cutters can be made by any *lohar* and may be bought for a couple of annas: the finer sorts are made in Rampur and Shahjahanpur and may cost as much as three rupees or even more. There is a village, Pachperwa, in the Allahabad district, where are four or five householders of *lohars* who have a considerable local reputation for the manufacture of *sarotas*. They furnish an interesting example of a very small rural industry. Their finest production only costs six annas. It is made of *sulis* or soft iron with some *ispat* (steel) in the blade; the handles are ornamented with little bands of copper and indented with a rough design. The blade has small holes pierced with the augur. The article is smothed and polished with a file: and the blade sharpened on a whetstone of home manufacture. The materials—iron, steel, copper, and little borax *(sohaga)* for welding—are obtained from a neighbouring bazaar. The tools used are all of home manufacture, save a couple of English files. For gripping small pieces

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of metal these men use a small wooden vice *(karsugahi)*, consisting of two bent pieces of wood hinged together in the middle; one pair of ends are forced apart with a wedge: this brings the other pair of ends together, so that they grip the metal inserted between them. The whole is often held in position by the workman's foot as he squats at his work. Indeed, to the Indian *lohar* his foot is often as useful as a third hand.

The methods of *sarota* makers at Rampur and elsewhere are little less primitive. But the finishing is much finer: and there is a division of labour, as a *saiqalgar* is called on to do the polishing. The metal handles are sometimes encased in bone. The centre and back of the blade are ornamented with fretwork regular in design and of considerable delicacy. Holes are made with the augur and the rest picked out with a fine file. A compass is used to mark the limits of the pattern where it is circular: but save for this, the work is done "*nigah se.*" The work on the edge or back of the blade, called *jalidar*, is sometimes very dainty, as where the design consists of a series of little doves. One man can make a good *sarota* in two days and sell it for a couple of rupees.

In Shahjahanpur, the manufacture of *sarotas* is of some importance: it is estimated that the annual value of the output is Rs. 13,000. *Saiqalgars* are a fairly numerous community—enough so to quarrel for precedence with the butchers at Moharram time. Here, as at Rampur, *sarotas* of considerable elegance are made; but the greatest demand is for those which cost from five pice to four annas. Shahjahanpur *sarotas* are exported to Delhi, Lahore, Lucknow, Cawnpore, Meerut and elsewhere.

But the most important cutlery industry in the Provinces is that of the scissors makers of Meerut. Meerut scissors have a wide reputation and are sold all over the provinces. According to the Census returns Meerut had in 1901 seventy-seven persons engaged in the three branches of the knife and tool industry; but inquiries recently made show that there are in fact about 220 persons at work on the manufacture of scissors, distributed among twenty shops. An estimate of the annual value of the outturn is about Rs. 32,000. Not less than two-thirds of this is for export.

The scissors are made of *sulis* bought in Delhi at eight rupees a maund. For the blades, files are used, costing ten rupees a maund. The first step in the manufacture is to hammer out a piece of iron of

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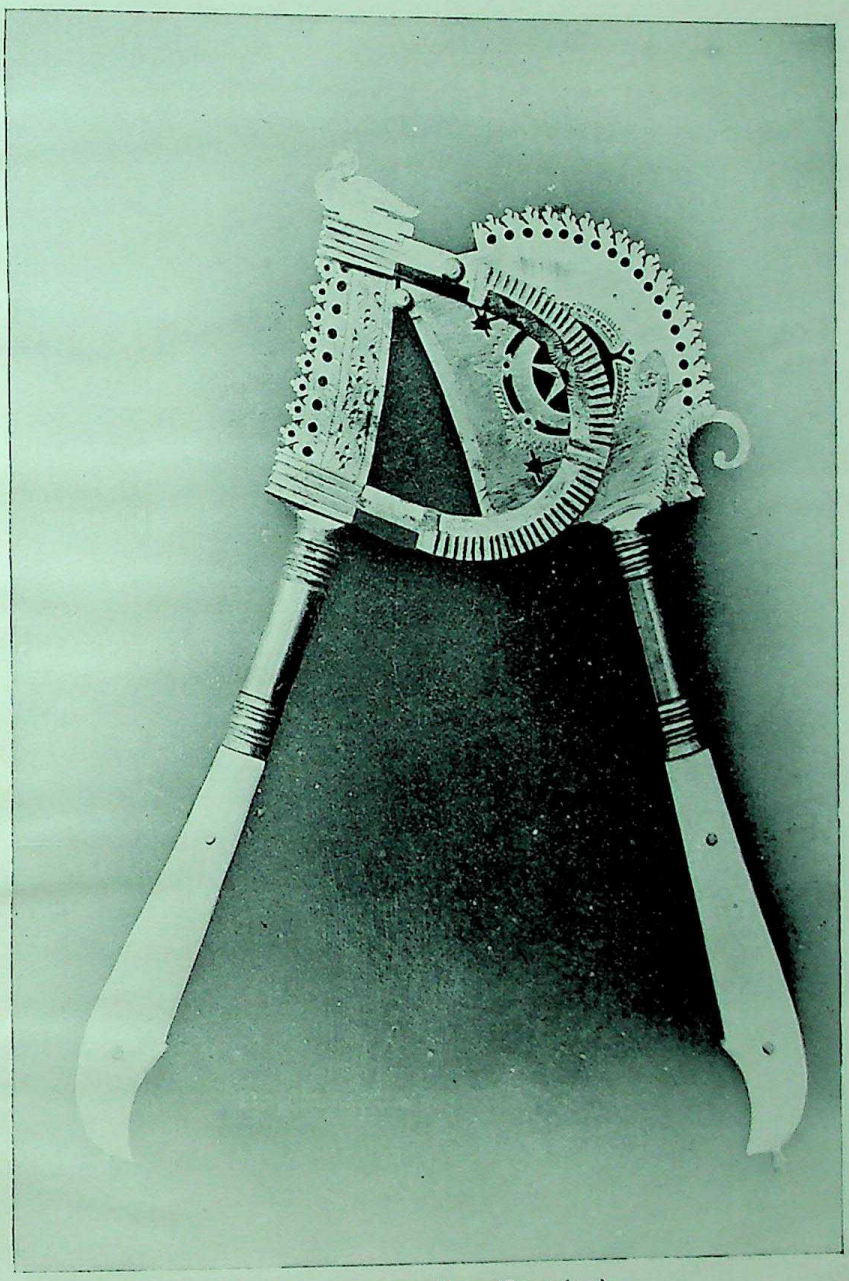

Betel-nut cutter (Sarota.)

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the length required. A piece of steel is then welded on to one end of this, borax being liberally used in the process. The other end of the iron is then drawn out and bent round to form the ordinary scissors handle or "bow": For this is used the small anvil with the pointed end, known as *ikwai*, which corresponds to the English "beak iron." The blade and handles are filed smooth. They are then handed over to the sharpeners, working at the whetstone, and after that they go to the *saiqalgar* to be polished: when they come from him, blades of the same size are rivetted together, to form a complete pair of scissors. A final finishing is given, the maker's name is indented and they are ready for packing. In a typical shop the following men were found at work: two owners, superintending, finishing and packing, etc.: two men at the forge, and a boy to work the bellows: one boy for filing the handles: three men for hammering and filing the blades: one man for joining the two portions together. This does not take into account the polisher, who works apart.

The following figures, furnished by the shopkeeper, give some idea of the cost of production. They apply to the scissors known as No. 24, of which perhaps a dozen are made in a day and are sold at Rs. 4-8-0.

Of the men at the forge, one hammerer gets a rupee a dozen, the other (heavy) hammerer gets three annas, and the blower gets two pice: the boy who files the handles gets three annas, the blade filer six annas. The man at the whetstone is paid four annas and his "puller" three annas. The *saiqalgar* is paid six annas, and the man who rivets the blades four annas. The man who holes the blades, for the rivet, receives two pice for a dozen holes. Thus wages come to Rs. 2-14-6, the owner doing the finishing and packing. Besides this, charcoal costs four annas, half a seer of steel costs Rs. 2, $1\frac{1}{2}$ seer of iron Rs. 5, and borax three pice: wear and tear of the whetstone is four annas. Roughly, therefore, it costs four rupees to turn out a dozen scissors which sell for Rs. 4-8-0. This only leaves a dozen rupees a month profit to the owner. In fact, his gains must be considerably more: in this particular case the wages of the first hammerer seem very high unless he be one of the employer's family.

The process of scissors making now practised at Meerut is almost exactly similar to that existing in Sheffield before the introduction of machinery. In Meerut, the only approach to a machine tool to be seen is an augur *(barmi)* worked by a screw, replacing the primitive bow and cord.

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The scissors industry at Meerut might be worth development. It has one great factor of a successful business—a hold on the market, for Meerut scissors are well known, and even when exported to the other end of the Provinces, their price is low as compared with that of the American article. Meerut, it is true, is not near to sources of supply of the metal required, though a revival of the Kumaun iron industry might partially remedy this defect; but it is well situated as a distributive centre for the whole of Upper India. Further, it has a large nucleus of men whose calling is that of scissors-maker: they would have to learn much; but their skill could hardly fail to help them, even with new methods.

Scissors were formerly manufactured at Cawnpore and their makers earned some notoriety by being prosecuted for forging a well known English trade mark. The industry is now of no importance, but there are several households of knife-makers and *saiqalgars* in the city.

Knives are made at many places, from the large butcher's blade to the small pocket knives that are seen for sale on many Railway platforms. Such pocket knives are made at various towns including Benares, Allahabad and Cawnpore. They are entirely of metal and the steel used is that which comes as the binding of packing cases. It is filed and polished and the blade is tempered: a rough pattern is scratched on the handle. Some of these knives have several blades, corkscrew, etc. Neatly finished pen-knives with sandal-wood handles are made at Khairana in Muzaffarnagar district, and find a ready market in the neighbourhood at five or six annas apiece. At Hathras a small knife-making industry has existed for over a hundred years: at the present time it gives employment to only twenty-two persons. But Hathras knives have a good name and even now about 30,000 are produced in the year. Their cheapness, for the best only costs three annas, makes the annual value of the out-put almost trivial; but, at Hathras as at Meerut, there are circumstances which might induce a capitalist to put a little money into the development of cutlery.

Before leaving the subject of cutlery, the methods of grinding and polishing must be described.

For grinding a circular whetstone *(san)* is used. It is mounted on a wooden axle, one end of which is usually inserted on the wall, while the other end rests horizontally on a wooden support. A circular motion is given by a cord or strap fastened to the axle. The wheel

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is made of sand, or powdered *kuran* stone, lac and oil. The sand is heated, then the lac and oil are mingled with it and the mixture is kneaded flat, hammered or cut into a circular shape, and allowed to cool. When working, the lower edge of the wheel passes through sand placed beneath it on the ground.

Polishing, as before mentioned, forms in many places a distinct occupation. The chief instrument of the *saiqalgar* is his *maskila*. It is a curved, flat piece of highly polished steel: in some places it is horseshoe shaped, while elsewhere the end by which it is held is straight and fitted into a wooden handle. For rubbing the oil on the *maskila* a board called *bed mal* is used. The *randa*, another steel instrument, sometimes resembling the *maskila*, is used for scraping the surface to be polished. A steel *kalam* is used for corners. The final polishing instrument is called a *chapras*, it is of horn mounted on wood. The horn is lubricated with oil and powdered *kuran* stone.

LOCKS.

Padlocks are of universal use, even in the villages: most houses require at least one, for chaining up the entrance door. Accordingly, locks are made probably in every district. Some of them bear a greater resemblance to a "puzzle" than to an ordinary padlock, and are very cheap: others display the exercise of considerable skill and ingenuity. Even in very small towns may sometimes be found *lohars* who make really strong, useful padlocks, some simple, others requiring three keys to open them, or ringing a bell when the key is turned, and so on. At Aligarh, the skill of the native in lock-making reaches its greatest height and has led to the establishment of a European firm whose products, it is claimed, rival those of the famous "Chubb's."

The training given in the Postal Workshops (established in 1841) gave an impulse to lock-making in Aligarh. In the eighties of the last century the industry spread, and there are now twenty-seven indigenous lock-works, the oldest only dating back to 1887: and at Iglas about twenty miles from Aligarh, there are eleven. The total number of workers in both places is 850. Boys are trained from the age of six and are experts after a couple of years' apprenticeship.

In Aligarh shops, the locks are made by hand; but moulds are used and the process has been influenced by European experience. The cost of production varies with the size of the lock and measurement of

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the lever. As an instance may be taken a 3-inch iron lock with a No. 6 leverage : it costs a rupee to make and is sold for Re. 1-5-0 : on a $1\frac{1}{2}$-inch lock, with the same leverage, there is a profit of six pice only. The locks made at Iglas are sent to Aligarh for finishing.

At Aligarh both brass and iron locks are made : the figures as to output do not discriminate between brass and iron locks, but iron locks are not made in size less than $1\frac{1}{2}$ inch, nor with a leverage of under 4 inches. It is estimated that Aligarh produces about 502,000 locks annually : these are sold for Rs. 2,76,000, which represents a profit of Rs. 19,000 on the cost of production. The annual output of locks from Iglas is about Rs. 30,000.

TRUNKS.

"Allahabad steel travelling trunks" have a considerable reputation in the market. It is apparently not founded on any extraordinary merit of the trunks, nor is the manufacture one requiring much skill. But the boxes are useful and cheap and "they supply a want." Allahabad has not a monopoly even in the south of the Provinces as these trunks—the familiar yellow objects so conspicuous on Railway platforms—are made at Benares also. Doubtless their production is stimulated in both cities by the crowds of travellers who come on pilgrimage to Prayag and Kashi.

There are several firms—mostly Musalman—engaged in their manufacture at Allahabad. The material used is soft sheet iron, procured from Calcutta : this is cut, with a big shears, into pieces of the required length, which are then bent and ridged. A small T-shaped iron used for bending little pieces is called *kapwa*. The hinge is made with strong wire : and the lock is a cheap German article. The top of the box is strengthened with a double thickness of iron and studded with rivets. The boxes, which are made in various sizes, are painted yellow before being put on the market. Besides the local sale, there is a considerable export of them to neighbouring districts.

Chapter V.

AGRICULTURAL IMPLEMENTS.

Miscellaneous.

The conservatism of the Indian cultivator is proverbial. Experts have found that, based as it is on the inherited experience of ages, it is

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oftener than not justifiable by very sound reasons. The plough of the Kurmi is by no means so contemptible an instrument as it would appear to a farmer of the English Midlands.

Be that as it may, while agricultural capital is so restricted and holdings are so small, we are not likely to see much use in India for the elaborate agricultural machinery of modern England or America. Even the co-operative movement will hardly do much in this direction for a very long time. In the preparation of products it may do a great deal: in the actual field operations, from ploughing to stacking, present methods will hold sway. Even in parts of the United Kingdom, the scythe and the sickle are still familiar tools.

Of the thousands of iron workers in these Provinces by far the greater number are employed in making ploughshares and other agricultural implements, or such homely domestic necessaries as cooking vessels, buckets and sieves.

The equipment of the village *lohar* has been described in Chapter I. His duty is to supply his clients with the implements of husbandry —more particularly the iron parts thereof—and to keep in good repair those already made. His clients generally supply the material and the charcoal. In return he gets a certain allowance of grain: which may take the form, in accordance with a fixed local scale, of a seer or two at ploughing, a few sheaves at reaping and a measured quantity of cleaned grain from the threshing floor. Besides this it is generally the custom for a cultivator to give his *lohar* a "feed" every year. In those villages where iron sugar mills have been introduced, the customary allowance of grain is often supplemented by a rupee in cash for each mill kept in working order.

It is recorded that there were in 1903-04 half a million ploughs in these Provinces. These ploughs are all of the primitive type which does not carry a "share," properly so called: the earth is turned up by a wedge-shaped wooden beam *(ankari)* shod with iron. The iron portion is called *phar* or *pans*, and is a straight bar generally about two feet long and weighing $1\frac{1}{2}$ to two seers. It is set in the underside of the *ankari* to which it is bound by a staple called *kati*: the working end is pointed and slightly bent upwards. Ploughs vary mostly in the wooden parts and the *phar* is of a fairly uniform type, but in Meerut and Saharanpur it is customary to use larger ploughs and also a larger iron, which can be driven forward as the point wears away. Sometimes a reversible iron is found, pointed at both ends. In parts of

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Bundelkhand the head of the iron is flatter and broader than in the normal type—probably to fit it for dealing with *kans* roots and other obstacles. The plough iron, like other rustic tools, is generally made out of *sulis*, which can be bought in the bazaar at from two to three annas a seer.

In the Mar and Kabar soils of Bundelkhand is used a *bakhar* —a plough whose iron bears more likeness to a "share." It is in fact a hoe, four or five inches broad and two feet wide. It is connected at the sides by wooden bars, about three feet long, with a beam which acts as a clod crusher. It is driven with oxen like a plough.

The hoe proper *(khurpa, khurpi)* varies somewhat in make according to the depth and nature of the soil where it is used. *Belcha*, the garden hoe, is straight and long. *Kodarya*, a broad hoe found in the North, is used for sugarcane; *kassi*, a small hoe or mattock, is also used in cane fields. *Khatpadara* is the name given in Mainpuri to a hoe used in transplanting tobacco. *Gainta* is a pickaxe, *kodari* being the name of the one-sided variety. *Phaora* is a shovel.

For reaping, a sickle *(hansiya* or *daranti)* is used: in some places it has serrated edges. The *gandasa* or fodder chopper is a broad blade fitted, hatchetwise, in a short handle.

Besides these things a *lohar* has to look after the iron fittings of certain simple machinery. The well bucket *(moti)* must have its iron collar *(kadra)* and handle *(karra* or *mandal):* the ginning mill has a piece of iron called *takooa*, which acts as a cog wheel: the sugar press must be kept in order. A village *lohar* cannot repair the most essential parts of the sugar press—the cast-iron rollers; but we may hope that in time the larger rural centres will boast of workmen who can do this and similar work. Already in Mohanlalganj, in Lucknow district, there are some *lohars* who possess a lathe which cost them Rs. 500, for the express purpose of repairing and perhaps making sugar mills.

In addition to all these things, the rustic smith sometimes makes simple cutlery, mends locks, and provides tools for other tradesmen such as the carpenter's adze *(basula)* or the *rapi* of the leatherworker.

The manufacture of boiling pans, buckets, etc., is outside the sphere of the ordinary village *lohar:* and is carried on in places of some size or local importance. The caldrons for boiling *gur* known as *karahas*, are made of rivetted sheet iron. Well buckets *(dols)* and other buckets *(baltis)* are also to be found in every bazaar. *Dols* are of various sizes: galvanized iron (usually called *saeban ke chaddar*, from

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its frequent use in roofing verandahs and balconies) is now often used in their manufacture. Iron vessels for carrying or holding water, corresponding to the earthen *ghara*, are known as *gagra*: they are usually made of rivetted sheet iron and sold at about 4½ annas a seer. A slightly higher rate is paid for *gagras* soldered instead of rivetted: Mirzapur has a small export trade in such vessels. *Chalna* is a large square sieve, *chalni* the smaller round one. The commonest cooking vessel is the almost flat iron plate called *tawa*, used for making *chapatis*: the *karhai* is a quarter-spherical caldron in which pulse, etc., is cooked. The stove *(angeti)*, portable oven *(tijal)*, pumpkin-grater *(kaddu kash)*, ladles *(kalchul)*, tripods *(tipay)*, firetongs *(chimta* or *dastpanah)*, tongs for lifting hot vessels *(sansi)*, strainer ladles *(jhara)*, grating for charcoal *(jhanjri)* are other items of a cook-house outfit, and these articles along with staples *(kundis)*, nails and pegs *(golmekh, kila)* and bird cages *(pinjra)* are the characteristic furniture of a hardware shop, and are sold by weight.

In large towns may also be found small firms who apply themselves to making a particular article: one man may make only *kila kanta*, while his next door neighbour specializes in shovels and a third party devotes himself to horseshoes. Dr. Hoey noted in 1878 that the manufacture of horseshoes was very profitable: they were made of scrap iron and sold to the *nalband* at a rupee for four seers. This is about the rate which still prevails; and if the maker of the shoes makes a handsome profit, the farrier *(nalband)* sometimes does so too. The *nalband* gets about sixteen pony shoes or a score of bullock shoes for a rupee. He is content with a small return while dealing with *ekka-walas*, from whom he demands only six pice per hoof; but when he shoes a Sahib's horse, his charge is six annas per shoe at least. The *nalband's* tools include pincers, awl, anvil, hammer, file *(sohan)* and hoof-parer *(sumtarash)*: and he has a cord called *pozmal* for tying round the ears of a refractory horse.

Finally, the *lohar*, whether as a *mistri* working on his own account, or as the workman of some small contractor, does a quantity of miscellaneous work and makes or repairs the indispensable adjuncts of many a modern product; among such may be mentioned tires and springs for vehicles, fittings for furniture and sanitary requisites for Municipalities.

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Lucknow

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